The Meade Instruments 161,000-sq. ft. manufacturing facility in Irvine, California. The company employs 500 people worldwide in the manufacture and distribution of quality optical products. The company's observatory houses a Meade 16" LX200GPS Schmidt-Cassegrain telescope with piggybacked 7" *ED* apochromatic refractor.

A Meade Instruments Factory Tour

The Meade Irvine, California, facility is one of the largest and most advanced commercial telescope manufacturing operations in the world. The Meade factory includes the latest in CNC (Computer Numerically Controlled) glass- and metal-working machine tools, electron beam vacuum coaters, and interferometric and laser-autocollimator optical testing devices. Keeping up with modern optical technology is an expensive process at Meade Instruments — but one which is absolutely vital to our continuing world leadership in the production of serious astronomical instrumentation for the knowledgeable amateur or for the school or university program.

The great majority of the materials and labor required to manufacture Meade 3.5" through 16" Schmidt-Cassegrain and Maksutov-Cassegrain telescopes and 4" through 7" *ED* apochromatic refractors, and many other products, is expended in our Irvine factory: these Meade telescopes — including the optical systems, coatings, machining, and fabrication of the mechanical and electronic mounting systems — are truly designed and made in the USA.

The export market is one of the most rapidly growing areas of Meade Instruments. At our wholly-owned subsidiary **Meade Instruments Europe GmbH** in Borken, Germany, Meade telescopes and accessories are marketed and shipped throughout Europe and the Middle East. In addition Meade products are sold worldwide in over 50 countries through a network of authorized Meade international distributors. Japan and Germany — countries well known for their technological expertise — are strong purchasers of Meade telescopes and accessories, notwithstanding the direct competition we face from numerous telescope manufacturers within those countries.

This brief tour of the Meade factory focuses on key areas that have made the Meade reputation for quality, areas that separate Meade Instruments from other telescope manufacturers.

Optical Coatings; Ultra-High Transmission Coatings: At our Irvine coatings facility Meade technicians use the latest electron-beam vacuum coating systems to deposit, at high temperature, the optical coatings included as standard equipment, or available optionally, with Meade telescope systems. Standard equipment includes in all cases an aluminum coating of extraordinary (99.99%) purity on mirrors, and, in telescopes which incorporate a correcting lens (*e.g.,* Meade ETX, Schmidt-Cassegrain, and Schmidt-Newtonian telescopes), magnesium fluoride (MgF_2) high-transmission coatings on both sides of the lens. The revolutionary Meade Ultra-High Transmission Coatings (UHTC) group *(p. 26)* was perfected at Meade Instruments over a period of almost one year and was made possible by the installation of highly specialized coating instrumentation unique in the commercial telescope industry to our company.

SC Primary Mirror Central Coring; Objective Lens Shaping: Before a Meade Schmidt-Cassegrain primary mirror can be polished and figured to within exacting optical tolerances, the central perforation, or core, of each mirror blank must be precision diamond-ground into the blank. In the Meade optical shaping department this operation is performed on a 5-axis CNC glass-machining center. The result is a mirror perforation (ready to accept the primary mirror baffle and focusing mechanism) that is within arc minutes of perfection — a perfection that, with minor final adjustment by optical alignment technicians *(see below)*, virtually eliminates mechanically induced aberrations in the Schmidt optics. The same CNC 5-axis machining center is used to diamond-mill the surface of each Meade APO objective lens surface; the lens blank is then automatically flipped, edged, and the reverse surface similarly diamond generated-to-radius.

Initial pitch-polishing of Schmidt-Cassegrain primary mirrors in Meade polishing rooms.

Polishing and Hand Figuring: After a Schmidt-Cassegrain, Maksutov-Cassegrain, *ED*/APO, or Schmidt-Newtonian glass surface is generated to radius and fine ground, the mirror or lens is placed on

an inverse-matched-radius pitch tool for polishing, a process that can require up to a continuous 16 hours or more. This polishing procedure returns the glass to full transmission or reflectivity, with all optical radii now very near their final values. It is at this point that Meade master opticians perform the final lens or mirror shaping (a process called *figuring*). In the case of Meade Schmidt-Cassegrains and Maksutov-Cassegrains, each optical set is *individually hand-figured* to reach an

Aluminum coating deposition in the optical coatings room.

optical null. Each apochromatic lens and Schmidt-Newtonian primary mirror is similarly hand-rubbed with sub-diameter pitch tools, the optician removing millionths of an inch to turn what would have been a good optical surface into one of the finest obtainable.

Optical Testing: As each Meade *ED* apochromatic objective lens, ETX Maksutov optical set, Schmidt-Cassegrain or Schmidt-Newtonian optical set, or parabolic Newtonian primary mirror progresses through the grinding, polishing, and final hand-figuring stages of development, it is continuously tested and re-tested for zonal irregularities, smoothness of figure, and correction. Intermediate testing is performed using the Foucault and Ronchi methods; final diffraction image testing is done with a double-pass laser autocollimator that passes an intense pinhole of monochromatic light (or, in the case of the APO lenses, white light, so that color correction may also be measured) through the optical system twice, enabling the technician to detect errors (at effective magnifications of 800X to 1000X) beyond the observable limit of the field user. If we seem unusually confident in the capabilities of Meade optical systems, it is because we know that every optical set is put through this battery of over 30 separate optical tests and inspections before the optics are mounted in their respective optical tubes and shipped to you.

Optical Alignment and Centration: Finished, individually-hand-matched Maksutov and Schmidt-Cassegrain optical sets and matched *ED* doublet objective lenses are sent to the optical alignment and centration department, where each optical set is placed into a special optical fixture that permits rotation of the optical elements about their optical axes. (The relative rotational orientations of the Schmidt-Cassegrain primary mirror, secondary mirror, and correcting plate, as well as the relative rotational orientations of the ED/APO doublet components, for example, are *not* arbitrary.) Rotation of the optics, while the technician observes an artificial starpoint under controlled laboratory conditions at high power, yields the unique relative orientation that cancels out any residual aberrations in the system. With optimal orientation thus fixed, each optics set is placed into the machined housings of the optical tube or ED/APO collimation lens cell. The optical system is once again tested for roundness, regularity, and

Installing the Declination assembly of the 16" Schmidt-Cassegrain.

consistency of the diffraction image inside and outside of focus. Only after passing this final test is an optical tube system ready to become part of a Meade Schmidt-Cassegrain, Schmidt-Newtonian, Maksutov-Cassegrain, or *ED* apochromatic refracting telescope.

Quality Control: As part of the final quality control inspection, each optical system is examined for any coating sleeks or scratches that may affect performance and which may have occurred in the manufacturing process. Electromechanical systems, including electronic circuit boards, are tested and burned-in for a period of 24 hours. Telescopes which pass this final series of tests are then packed and shipped to authorized Meade dealers throughout the world.

MEADE LIMITED WARRANTY

Every Meade telescope, spotting scope, and telescope accessory is warranted by Meade Instruments Corporation ("Meade") to be free of defects in materials and workmanship for a period of ONE YEAR from the date of original purchase in the U.S.A. and Canada. Meade will repair or replace a product, or part thereof, found by Meade to be defective, provided the defective part is returned to Meade, freight-prepaid, with proof of purchase. This warranty applies to the original purchaser only and is non-transferable. Meade products purchased outside North America are not included in this warranty, but are covered under separate warranties issued by Meade international distributors.

RGA Number Required: Prior to the return of any product or part, a Return Goods Authorization (RGA) number **must** be obtained from Meade by writing, or by calling (949) 451-1450. Each returned part or product must include a written statement detailing the nature of the claimed defect, as well as the owner's name, address, and phone number.

This warranty is not valid in cases where the product has been abused or mishandled, where unauthorized repairs have been attempted or performed, where auxiliary products of non-Meade manufacture have damaged the telescope, or where depreciation of the product is due to normal wear-and-tear. Meade specifically disclaims special, indirect, or consequential damages or lost profit which may result from a breach of this warranty. Any implied warranties which can not be disclaimed are hereby limited to a term of one year from the date of original retail purchase.

This warranty gives you specific rights. You may have other rights which vary from state to state.

Meade reserves the right to change product specifications or to discontinue products without notice.

This warranty supersedes all previous Meade product warranties.